MCI Communications Corporation

1801 Pennsylvania Avenue, NW
Washington, DC 20006

EX PARTE OR LATE FILED

EX PARTE

May 5, 1999

Magalie Roman Salas, Secretary
Federal Communications Commission
445 12th Street, S.W., TW-A325
Washington, D.C. 20554

Re: Ex Parte Submission
Federal-State Joint Board on Universal Service; CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs; CC Docket No. 97-160

Dear Ms. Salas:

On May 4, 1999, Rich Clarke, Mike Lieberman, and Joel Lubin representing AT&T, and Mark Bryant and I representing MCI WorldCom, met with Commission staff to discuss several issues regarding the Synthesis Model. Attending for the Commission were Craig Brown, Chuck Keller, Katie King, Bob Loube, Jeff Prisbrey, Richard Smith, and Don Stockdale. The attached documents summarize the issues discussed. Please associate it with the above-captioned dockets.

Respectfully submitted,

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Senior Economist
MCI WorldCom
1801 Pennsylvania Ave., NW
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(202) 887-2731

cc: Craig Brown, Abdel Eqab, Chuck Keller, Katie King, Bob Loube, Jeff Prisbrey, Richard Smith, Don Stockdale, Sheryl Todd

AT&T and MCI WorldCom Ex Parte

May 4, 1999

SM issues that appear to have been largely addressed in the April 20 release

1. Development of annual charge factors for optimization routines (assuming that maintenance expense is properly added)
2. Optimization of the use of DLC to serve customers within the 18 kft. distance limit (appears to have been addressed through the use of alternative clustering algorithms and logic changes)
3. Optimization of structure percents (but an anomaly appears that underground plant seems to be less costly than buried plant in upper density zones)

SM issues that appear to remain unaddressed in the April 20 release

1. Continued use of "all road surrogate" data, even when actual geocode data is available
   - 1.1. No question exists but that the actual geocode data is more accurate data
   - 1.2. Transfers previously clustered points in higher, less expensive density zones into lower, more expensive density zones
   - 1.3. Raises significantly computed average monthly cost and USF
   - 1.4. Bias is extremely uneven, appears artificially to elevate cost the greatest in the West, and the least in the Northeast
2. Assumed input prices for investment goods remain severely elevated (e.g., copper cables, placement, DLC, switches, etc.)
   - 2.1. Methodologies used to establish these prices frequently appear to diverge from the methodologies announced by the staff at the inputs workshops
   - 2.2. Frequently, they appear to rely on data supplied by ILECs that are:
     - 2.2.1. Non-public
     - 2.2.2. Unaudited
     - 2.2.3. Self-selected and censored
     - 2.2.4. No longer current and indicative of forward-looking costs

2.3. Any data relied on to establish these input values should either be public, or identified specifically so that it may be examined by interested parties.

3. Structure percents are anomalous and sharing percents remain too low
   3.1. Result is investment patterns that show significant disparities from likely economic patterns
   3.2. Also anomalous are expense patterns relative to likely economic patterns
4. All of these issues drive currently modeled costs above forward-looking economic levels
5. Maintenance factor patterns are confusing

Other items

1. Analog copper loop distances that can be served from central offices or DLC remote terminals
2. Placement of host/remote connecting circuits on rings, and rings separate from standard interoffice rings
3. Employment of most recent expense module to model accelerated tax depreciation and ELG regulatory depreciation, etc.
4. Content of any further revisions
5. Provision of a fully packaged model
6. Opportunity for further review

UNEXPECTED RELATIONSHIP BETWEEN UNDERGROUND AND BURIED

Loop Cost by Zone

SBAL	0-5	5-100	100-200	200-650	650-850	850-2550	2550-5000	5000-10000	>10000	Total
Aerial	192.32	59.38	26.51	19.41	16.45	13.38	9.87	8.47	7.17	24.87
Buried	236.18	74.01	33.89	27.89	23.95	18.97	14.84	11.30	8.53	33.10
UG	304.29	92.02	37.90	27.02	21.82	17.08	13.32	10.40	8.01	35.90

BADC	0-5	5-100	100-200	200-650	650-850	850-2550	2550-5000	5000-10000	>10000	Total
Aerial	0.00	0.00	0.00	0.00	0.00	12.72	11.50	10.11	7.36	8.46
Buried	0.00	0.00	0.00	0.00	0.00	18.18	17.44	14.33	8.57	10.87
UG	0.00	0.00	0.00	0.00	0.00	15.88	15.01	12.58	8.00	9.83

Buried to UG ratio :SBAL Investment

	0-5	5-100	100-200	200-650	650-850	850-2550	2550-5000	5000-10000	>10000	Total
Cable	1.00	1.02	1.06	1.07	1.08	1.09	1.09	1.11	1.13	1.04
Structure	0.61	0.62	0.77	1.09	1.25	1.25	1.27	1.27	1.27	0.80
Both	0.70	0.71	0.83	1.08	1.22	1.22	1.24	1.24	1.24	0.85

NYNEX Maine

Impact of 100% Road Surrogates

	Actual + Road	100% Road	% Change
Monthly USF Cost	$ 34.14	$ 34.65	1%
Investments			
NID	$ 20,124,421	$ 20,260,380	1%
Distribution (DLC)	$ 473,861,096	$ 490,618,320	4%
Distribution (non-DLC)	$ 173,011,823	$ 177,463,252	3%
Distribution (all)	$ 646,872,920	$ 668,081,573	3%
Concentrator (DLC)	$ 121,302,749	$ 120,804,310	0%
Concentrator (non-DLC)	$ 3,382,626	$ 3,262,386	-4%
Concentrator (all)	$ 124,685,376	$ 124,066,695	0%
Feeder (DLC)	$ 67,026,441	$ 65,210,733	-3%
Feeder (non-DLC)	$ 26,806,296	$ 25,152,258	-6%
Feeder (all)	$ 93,832,736	$ 90,362,991	-4%
End Office Switching	$ 87,445,759	$ 87,410,929	0%
Signaling	$ 6,884,311	$ 6,883,263	0%
Dedicated Transport	$ 32,854,442	$ 32,880,145	0%
Dedicated Transport Transmission	$ 6,172,648	$ 6,172,184	0%
Direct Transport	$ 40,803,341	$ 40,835,730	0%
Direct Transport Transmission	$ 6,796,655	$ 6,796,747	0%
Common Transport	$ 19,488,368	$ 19,506,307	0%
Common Transport Transmission	$ 3,127,171	$ 3,127,554	0%
Tandem Switching	$ 3,635,456	$ 3,635,411	0%
Operator Systems	$ 9,888,056	$ 9,883,769	0%
Total Investment	$ 1,102,611,659	$ 1,119,903,678	2%
USF Loop Cost by Zone			
0 - 5	$ 248.70	$ 252.09	1%
5 - 100	$ 62.73	$ 61.84	-1%
100 - 200	$ 27.88	$ 27.71	-1%
200 - 650	$ 21.09	$ 21.88	4%
650 - 850	$ 17.72	$ 18.69	5%
850 - 2,550	$ 15.79	$ 16.00	1%
2,550 - 5,000	$ 14.47	$ 14.82	2%
5,000 - 10,000	$ 10.87	$ 11.01	1%
> 10,000	$ 9.81	$ 9.92	1%
Total	$ 30.49	$ 30.99	2%
Total Lines by Zone			
0 - 5	2,243	2,281	2%
5 - 100	155,598	159,523	3%
100 - 200	65,335	64,727	-1%
200 - 650	161,706	169,928	5%
650 - 850	39,800	36,670	-8%
850 - 2,550	116,047	109,281	-6%
2,550 - 5,000	43,757	46,355	6%
5,000 - 10,000	29,492	26,732	-9%
> 10,000	15,684	13,802	-12%
Total	629,662	629,299	0%
USF Support	$ 70,998,271	$ 70,770,545	0%

NYNEX Vermont

Impact of 100% Road Surrogates

	Actual + Road	100% Road	% Change
Monthly USF Cost	$ 44.37	$ 44.72	1%
Investments			
NID	$ 9,440,579	$ 9,470,797	0%
Distribution (DLC)	$ 286,900,118	$ 290,234,912	1%
Distribution (non-DLC)	$ 73,591,693	$ 76,573,020	4%
Distribution (all)	$ 360,491,811	$ 366,807,932	2%
Concentrator (DLC)	$ 63,225,268	$ 63,327,068	0%
Concentrator (non-DLC)	$ 1,309,580	$ 1,233,504	-6%
Concentrator (all)	$ 64,534,848	$ 64,560,571	0%
Feeder (DLC)	$ 30,109,845	$ 28,750,956	-5%
Feeder (non-DLC)	$ 10,492,977	$ 9,814,817	-6%
Feeder (all)	$ 40,602,822	$ 38,565,772	-5%
End Office Switching	$ 37,695,981	$ 37,668,598	0%
Signaling	$ 4,380,331	$ 4,382,354	0%
Dedicated Transport	$ 21,651,130	$ 21,546,598	0%
Dedicated Transport Transmission	$ 4,942,719	$ 4,922,885	0%
Direct Transport	$ 16,333,561	$ 16,400,775	0%
Direct Transport Transmission	$ 3,304,766	$ 3,317,291	0%
Common Transport	$ 8,232,342	$ 8,271,917	0%
Common Transport Transmission	$ 1,650,629	$ 1,657,940	0%
Tandem Switching	$ 1,849,286	$ 1,849,582	0%
Operator Systems	$ 5,808,559	$ 5,818,278	0%
Total Investment	$ 580,919,365	$ 585,241,291	1%
USF Loop Cost by Zone			
0 - 5	$ 214.40	$ 218.34	2%
5 - 100	$ 65.44	$ 65.48	0%
100 - 200	$ 26.32	$ 26.99	3%
200 - 650	$ 21.67	$ 22.42	3%
650 - 850	$ 20.58	$ 20.45	-1%
850 - 2,550	$ 15.37	$ 16.75	9%
2,550 - 5,000	$ 14.35	$ 15.50	8%
5,000 - 10,000	$ -	$ 12.36	#DIV/0!
> 10,000	$ -	$ -	#DIV/0!
Total	$ 40.22	$ 40.57	1%
Total Lines by Zone			
0 - 5	807	741	-8%
5 - 100	101,463	101,155	0%
100 - 200	32,400	33,813	4%
200 - 650	56,318	52,213	-7%
650 - 850	7,752	8,193	6%
850 - 2,550	37,741	39,066	4%
2,550 - 5,000	8,942	4,572	-49%
5,000 - 10,000	-	5,301	#DIV/0!
> 10,000	-	-	#DIV/0!
Total	245,423	245,054	0%
USF Support	$ 48,219,356	$ 48,083,836	0%

US West Utah

Impact of 100% Road Surrogates

	Actual + Road	100% Road	% Change
Monthly USF Cost	$ 22.17	$ 22.70	2%
Investments			
NID	$ 30,996,914	$ 31,143,459	0%
Distribution (DLC)	$ 315,540,707	$ 342,179,669	8%
Distribution (non-DLC)	$ 260,423,769	$ 272,335,923	5%
Distribution (all)	$ 575,964,476	$ 614,515,592	7%
Concentrator (DLC)	$ 143,769,074	$ 142,551,937	-1%
Concentrator (non-DLC)	$ 7,028,770	$ 7,154,985	2%
Concentrator (all)	$ 150,797,845	$ 149,706,922	-1%
Feeder (DLC)	$ 80,535,647	$ 80,753,819	0%
Feeder (non-DLC)	$ 50,960,983	$ 50,958,525	0%
Feeder (all)	$ 131,496,630	$ 131,712,344	0%
End Office Switching	$ 121,329,537	$ 121,325,445	0%
Signaling	$ 6,177,574	$ 6,188,085	0%
Dedicated Transport	$ 49,522,526	$ 49,299,716	0%
Dedicated Transport Transmission	$ 31,455,666	$ 31,444,179	0%
Direct Transport	$ 16,065,946	$ 16,268,555	1%
Direct Transport Transmission	$ 3,874,466	$ 3,882,559	0%
Common Transport	$ 6,886,437	$ 6,974,658	1%
Common Transport Transmission	$ 1,153,883	$ 1,157,270	0%
Tandem Switching	$ 3,656,944	$ 3,657,036	0%
Operator Systems	$ 7,190,957	$ 7,232,922	1%
Total Investment	$ 1,136,569,799	$ 1,174,508,742	3%
USF Loop Cost by Zone			
0 - 5	$ 317.93	$ 310.30	-2%
5 - 100	$ 65.81	$ 63.49	-4%
100 - 200	$ 27.67	$ 27.77	0%
200 - 650	$ 22.07	$ 21.74	-1%
650 - 850	$ 18.64	$ 19.18	3%
850 - 2,550	$ 15.87	$ 16.09	1%
2,550 - 5,000	$ 13.83	$ 13.91	1%
5,000 - 10,000	$ 9.75	$ 10.12	4%
> 10,000	$ 7.99	$ 7.40	-7%
Total	$ 18.91	$ 19.43	3%
Total Lines by Zone			
0 - 5	1,917	2,682	40%
5 - 100	40,401	47,123	17%
100 - 200	48,358	47,929	-1%
200 - 650	175,856	184,521	5%
650 - 850	86,174	81,848	-5%
850 - 2,550	604,658	599,229	-1%
2,550 - 5,000	255,667	268,726	5%
5,000 - 10,000	87,223	74,161	-15%
> 10,000	38,851	32,828	-16%
Total	1,339,105	1,339,047	0%
USF Support	$ 21,380,137	$ 24,479,332	14%

US West Wyoming

Impact of 100% Road Surrogates

	Actual + Road	100% Road	% Change
Monthly USF Cost	$ 39.37	$ 42.66	8%
Investments			
NID	$ 7,099,533	$ 7,137,887	1%
Distribution (DLC)	$ 164,494,862	$ 210,080,667	28%
Distribution (non-DLC)	$ 56,149,961	$ 52,947,576	-6%
Distribution (all)	$ 220,644,823	$ 263,028,244	19%
Concentrator (DLC)	$ 64,272,491	$ 67,247,767	5%
Concentrator (non-DLC)	$ 1,326,503	$ 1,212,218	-9%
Concentrator (all)	$ 65,598,995	$ 68,459,985	4%
Feeder (DLC)	$ 91,495,672	$ 94,461,811	3%
Feeder (non-DLC)	$ 40,424,094	$ 37,164,396	-8%
Feeder (all)	$ 131,919,766	$ 131,626,207	0%
End Office Switching	$ 28,456,909	$ 28,453,264	0%
Signaling	$ 4,357,020	$ 4,357,408	0%
Dedicated Transport	$ 51,985,443	$ 51,957,271	0%
Dedicated Transport Transmission	$ 4,751,284	$ 4,750,835	0%
Direct Transport	$ 14,293,247	$ 14,298,485	0%
Direct Transport Transmission	$ 1,061,017	$ 1,061,498	0%
Common Transport	$ 8,039,922	$ 8,039,841	0%
Common Transport Transmission	$ 578,266	$ 578,253	0%
Tandem Switching	$ 1,670,254	$ 1,670,047	0%
Operator Systems	$ 5,387,854	$ 5,389,347	0%
Total Investment	$ 545,844,332	$ 590,808,572	8%
USF Loop Cost by Zone			
0 - 5	$ 362.99	$ 345.07	-5%
5 - 100	$ 93.25	$ 89.55	-4%
100 - 200	$ 38.91	$ 33.39	-14%
200 - 650	$ 27.59	$ 27.41	-1%
650 - 850	$ 22.30	$ 20.71	-7%
850 - 2,550	$ 17.64	$ 17.78	1%
2,550 - 5,000	$ 12.93	$ 12.72	-2%
5,000 - 10,000	$ 12.63	$ 11.69	-7%
> 10,000	$ -	$ -	#DIV/0!
Total	$ 35.83	$ 39.12	9%
Total Lines by Zone			
0 - 5	3,705	5,996	62%
5 - 100	27,385	29,790	9%
100 - 200	13,210	18,298	39%
200 - 650	68,145	80,266	18%
650 - 850	28,006	15,835	-43%
850 - 2,550	96,625	89,864	-7%
2,550 - 5,000	14,086	9,689	-31%
5,000 - 10,000	2,992	4,380	46%
> 10,000	-	-	#DIV/0!
Total	254,154	254,118	0%
USF Support	$ 35,078,276	$ 42,167,487	20%

Impact of 100% road Surrogates

	South Central Bell-Al	Diamond State Tel Co	C And P Telephone Company Of Wa Dc	Southwestern Bell-Kansas	New England Tel-Maine	South Central Bell-Mississippi	Nevada Bell	Northwestern Bell-South Dakota	Mountain Bell-Utah	New England Tel-Vt	C And P Tel Co Of W Va	Mountain Bell-Wyoming
Monthly USF Cost	3%	2%	1%	3%	1%	2%	2%	2%	2%	1%	1%	8%
Investments												
NID	1%	1%	-1%	0%	1%	-1%	0%	1%	0%	0%	0%	1%
Distribution (DLC)	7%	4%	21%	10%	4%	5%	7%	9%	8%	1%	4%	28%
Distribution (non-DLC)	3%	10%	5%	0%	3%	-2%	4%	1%	5%	4%	-1%	-6%
Distribution (all)	6%	6%	6%	7%	3%	4%	6%	7%	7%	2%	3%	19%
Concentrator (DLC)	0%	-3%	18%	2%	0%	0%	-3%	1%	-1%	0%	0%	5%
Concentrator (non-DLC)	-3%	0%	1%	-4%	-4%	-5%	1%	-4%	2%	-6%	-3%	-9%
Concentrator (all)	0%	-2%	5%	2%	0%	0%	-3%	1%	-1%	0%	0%	4%
Feeder (DLC)	-5%	-3%	9%	-4%	-3%	-4%	-4%	-7%	0%	-5%	-6%	3%
Feeder (non-DLC)	-12%	0%	-1%	-8%	-6%	-11%	10%	-16%	0%	-6%	-12%	-8%
Feeder (all)	-7%	-2%	0%	-5%	-4%	-6%	0%	-10%	0%	-5%	-8%	0%
Total Investment	3%	3%	3%	3%	2%	2%	2%	2%	3%	1%	1%	8%
USF Loop Cost by Zone												
0 - 5	-3%	73%	#DIV/0!	-2%	1%	-3%	-8%	-2%	-2%	2%	-3%	-5%
5 - 100	3%	-5%	#DIV/0!	-3%	-1%	-2%	-8%	-8%	-4%	0%	-2%	-4%
100 - 200	0%	1%	#DIV/0!	-2%	-1%	0%	2%	6%	0%	3%	-1%	-14%
200 - 650	0%	0%	#DIV/0!	5%	4%	3%	6%	-3%	-1%	3%	1%	-1%
650 - 850	4%	9%	#DIV/0!	0%	5%	2%	-23%	-3%	3%	-1%	7%	-7%
850 - 2,550	2%	1%	7%	1%	1%	3%	0%	-2%	1%	9%	0%	1%
2,550 - 5,000	4%	-1%	-1%	3%	2%	3%	0%	2%	1%	8%	-3%	-2%
5,000 - 10,000	5%	6%	1%	-5%	1%	5%	2%	-3%	4%	#DIV/0!	6%	-7%
> 10,000	0%	-5%	0%	6%	1%	4%	-3%	-100%	-7%	#DIV/0!	-1%	#DIV/0!
Total	3%	2%	2%	3%	2%	3%	2%	2%	3%	1%	1%	9%
Total Lines by Zone												
0 - 5	11%	-56%	#DIV/0!	5%	2%	17%	25%	3%	40%	-8%	10%	62%
5 - 100	0%	19%	#DIV/0!	9%	3%	3%	12%	18%	17%	0%	4%	9%
100 - 200	28%	-33%	#DIV/0!	23%	-1%	-13%	-3%	9%	-1%	4%	-12%	39%
200 - 650	1%	-1%	#DIV/0!	11%	5%	9%	-4%	30%	5%	-7%	19%	18%
650 - 850	5%	35%	#DIV/0!	-5%	-8%	-13%	60%	-13%	-5%	6%	-21%	-43%
850 - 2,550	-6%	1%	6%	-2%	-6%	-10%	-8%	-15%	-1%	4%	-8%	-7%
2,550 - 5,000	4%	13%	13%	-15%	6%	-9%	3%	-2%	5%	-49%	-14%	-31%
5,000 - 10,000	-18%	-13%	5%	-9%	-9%	-6%	8%	1%	-15%	#DIV/0!	-34%	46%
> 10,000	-9%	-26%	-3%	-10%	-12%	70%	-30%	-100%	-16%	#DIV/0!	12%	#DIV/0!
Total	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
USF Support	6%	3%	#DIV/0!	2%	0%	1%	7%	1%	14%	0%	1%	20%

Investment: SYN0420 100% Road Surrogate (Default) vs ARMIS

State	SYN0420 100% Road Surrogate	Poles	Aerial Cable	Underground Cable	Buried Cable	Conduit Systems	Total
Alabama	South Central Bell-Al	233,369	271,650	127,220	1,481,875	153,975	2,268,089
District of Columbia	C And P Telephone Company Of Wa Dc	1,446	1,883	70,668	92,958	69,733	236,687
Delaware	Diamond State Tel Co	27,460	33,393	34,667	245,682	40,260	381,463
Kansas	Southwestern Bell-Kansas	138,363	169,994	134,038	924,065	115,044	1,481,504
Maine	New England Tel-Maine	93,747	108,045	68,667	558,315	57,882	886,655
Mississippi	South Central Bell-Mississippi	269,268	301,819	121,768	1,449,649	141,192	2,283,697
Nevada	Nevada Bell	38,235	49,649	59,345	227,707	35,755	410,691
South Dakota	Northwestern Bell-South Dakota	47,843	58,785	48,161	266,906	31,889	453,583
Utah	Mountain Bell-Utah	58,767	76,792	97,139	544,772	88,143	865,613
Vermont	New England Tel-Vt	54,456	57,473	30,760	296,312	28,475	467,476
West Virginia	C And P Tel Co Of W Va	151,781	150,773	69,128	813,549	80,658	1,265,890
Wyoming	Mountain Bell-Wyoming	58,149	73,212	43,139	280,027	27,562	482,090
		1,172,883	1,353,468	904,701	7,181,818	870,567	11,483,437

	ARMIS	Poles	Aerial Cable	Underground Cable	Buried Cable	Conduit Systems	Total
Alabama	South Central Bell-Al	118,423	471,915	232,715	758,154	135,579	1,716,786
District of Columbia	C And P Telephone Company Of Wa Dc	4,090	45,749	131,312	3,847	60,578	245,576
Delaware	Diamond State Tel Co	9,419	76,719	61,798	139,022	46,162	333,120
Kansas	Southwestern Bell-Kansas	21,539	83,431	149,497	705,138	70,646	1,030,251
Maine	New England Tel-Maine	120,881	384,674	57,286	21,210	53,803	637,854
Mississippi	South Central Bell-Mississippi	88,690	445,040	97,056	689,950	63,939	1,384,675
Nevada	Nevada Bell	14,303	41,978	70,957	99,876	47,399	274,513
South Dakota	Northwestern Bell-South Dakota	4,924	9,592	37,971	183,650	24,345	260,482
Utah	Mountain Bell-Utah	13,704	52,084	135,665	466,842	101,848	770,143
Vermont	New England Tel-Vt	87,192	199,103	37,110	37,953	36,715	398,073
West Virginia	C And P Tel Co Of W Va	110,221	421,940	54,647	144,476	42,423	773,707
Wyoming	Mountain Bell-Wyoming	8,054	15,691	35,377	255,166	29,678	343,966
	12 Company Total	601,440	2,247,916	1,101,391	3,505,284	713,115	8,169,146

State	Ratio: SYN0420 to ARMIS	Poles	Aerial Cable	Underground Cable	Buried Cable	Conduit Systems	Total
Alabama	South Central Bell-Al	1.97	0.58	0.55	1.95	1.14	1.32
District of Columbia	C And P Telephone Company Of Wa Dc	0.35	0.04	0.54	24.16	1.15	0.96
Delaware	Diamond State Tel Co	2.92	0.44	0.56	1.77	0.87	1.15
Kansas	Southwestern Bell-Kansas	6.42	2.04	0.90	1.31	1.63	1.44
Maine	New England Tel-Maine	0.78	0.28	1.20	26.32	1.08	1.39
Mississippi	South Central Bell-Mississippi	3.04	0.68	1.25	2.10	2.21	1.65
Nevada	Nevada Bell	2.67	1.18	0.84	2.28	0.75	1.50
South Dakota	Northwestern Bell-South Dakota	9.72	6.13	1.27	1.45	1.31	1.74
Utah	Mountain Bell-Utah	4.29	1.47	0.72	1.17	0.87	1.12
Vermont	New England Tel-Vt	0.62	0.29	0.83	7.81	0.78	1.17
West Virginia	C And P Tel Co Of W Va	1.38	0.36	1.27	5.63	1.90	1.64
Wyoming	Mountain Bell-Wyoming	7.22	4.67	1.22	1.10	0.93	1.40
	12 Company Total	1.95	0.60	0.82	2.05	1.22	1.41

	SYN to ARMIS ratio analysis	Pole ratio to aerial cable	Conduit Ratio to Underground Ratio
Alabama	South Central Bell-Al	3.42	2.08
District of Columbia	C And P Telephone Company Of Wa Dc	8.59	2.14
Delaware	Diamond State Tel Co	6.70	1.55
Kansas	Southwestern Bell-Kansas	3.15	1.82
Maine	New England Tel-Maine	2.76	0.90
Mississippi	South Central Bell-Mississippi	4.48	1.76
Nevada	Nevada Bell	2.26	0.90
South Dakota	Northwestern Bell-South Dakota	1.59	1.03
Utah	Mountain Bell-Utah	2.91	1.21
Vermont	New England Tel-Vt	2.16	0.94
West Virginia	C And P Tel Co Of W Va	3.85	1.50
Wyoming	Mountain Bell-Wyoming	1.55	0.76
	12 Company Total	3.24	1.49

Loop Length Limits in Copper Cable Telephony

The ability of modern telephony loops to provide quality line supervision, ringing and loudness is limited by the transmission loss induced by the length and gauge of copper cable runs.[1] Transmission loss may be measured both in terms of electrical resistance (ohms) and signal loss (dB).

Resistance Loss

For digital switches or DLC remote terminals to provide quality line supervision and ringing, they must interoperate with loops that do not exceed certain DC resistance thresholds. Bellcore states that digital end office switches have simple resistance limits of 1600 to 2000 ohms, excluding the extra resistance presented by customers' station sets.[3] DLC systems generally have slightly smaller resistance limits of about 1500 ohms.[4] Because of this, we believe that the local loop network should be engineered not to exceed 1500 ohms of DC resistance. Standard industry figures for the DC resistance of copper cable are:

- 83.3 ohms per kilofoot (kft.) for 26-gauge cable, and
- 51.9 ohms per kft. for 24-gauge cable.[5]

Thus a loop resistance limit of 1500 ohms is not exceeded until 26-gauge cable spans exceed 18 kft. and 24-gauge cable spans exceed 28.9 kft.

Signal Loss

Signal strength in copper loops is primarily a function of AC impedance, and generally is measured in dB at 1 kHz for POTS services. This strength affects the "loudness" of the transmission. Opinions vary as to the acceptable dB loss allowed in the loop because it is dependent on human perceptions of loudness. The most widely accepted limit is 8.5 dB for total loss. For analog loops entering the central office (CO) on copper feeder, 0.5 dB of this budget must be reserved to account for loss associated with analog CO wiring. This leaves the net OSP loss budget for such loops at 8.0 dB.[6] For loops that enter the

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[1] The transmission characteristics of copper cables are also determined by their type of insulation, twist lengths and the ambient temperature. These factors, though, are only of second order influence relative to cable length and gauge.

[2] See, Bellcore, *Bellcore Notes on the Networks – December 1997*, p. 7-29.

[3] See, Bellcore, *Bellcore Notes on the Networks – December 1997*, p. 7-29.

[4] See, for example, Alcatel/DSC Litespan 2000 or AFC UMC-1000 product brochures. These brochures state that these DLC systems' total loss "budgets" are 1930 ohms, but that from this figure a maximum of 430 ohms should be subtracted to allow for the resistance of multiple station sets. [Ibid., p. 7-68.].

[5] Sources for these figures include, Bellcore's *Telecommunications Transmission Engineering* (p. 96), AT&T's *Outside Plant Engineering Handbook* (p. 5-13), and other documents.

[6] See Bellcore, *Telecommunications Transmission Engineering*, 1990, p. 102, which states in part, that loss "can slightly exceed 8.0 dB [8.5 dB including central office wiring losses – *Ibid. p. 103*] which can be taken as the maximum desirable insertion loss so that the mean and standard deviatiohn of loss

CO already at the digital level, such as those on integrated DLC, a full 8.5 dB of loss budget is available to cover loss incurred in the copper distribution cable as well as in the DLC remote terminal.

Different manufacturers build different levels of dB loss or gain into the line cards of their DLC remote terminals. Certain DLC manufacturers design their standard remote terminal line cards to be able to power copper distribution loops with zero dB loss, i.e., as if they acted as a CO.[7] Still other DLC systems, such as Alcatel/DSC's[8] Litespan 2000 engineer a 2.0 dB loss in their standard remote terminal POTS line card.[9] Typically, though, these DLC manufacturers also supply line cards that introduce no net AC impedance loss. For Alcatel/DSC's Litespan 2000 system, this "neutral" card is their standard POTS extended range card).[10] Still other cards may provide sufficient gain to boost signals to a negative loss level. The Litespan 2000 card with this capability is their special services extended range card.[11] Thus, depending on the DLC system specified and the particular line card employed, it is reasonable to assume that the loss budget available for the copper OSP distribution cable will range between 6.5 and 8.5 dB.

Signal Loss in Copper Cable

There are several alternative sources for information about the dB loss characteristics of different copper cables used in OSP. Alcatel/DSC Litespan 2000 documentation suggests that loss on 24-gauge cables is likely to be 0.37 dB per kft.[12] This suggests that 6.5 dB of loss would not be reached until cable lengths exceed 17.6 kft., and 8.5 dB would not be reached until lengths exceed 23 kft.[13] Freeman's *Fundamentals of Telecommunications* states that 24-gauge dB loss is 0.41 dB per kft.[14] This alternative figure would cause 6.5 dB of loss to be reached at 15.9 kft., and 8.5 dB to be reached at 20.7 kft.

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distributions in loop plant are not excessive." See also, *Bellcore Notes on the Networks – December 1997*, p. 7-75, "... no properly designed loop should have more than 8.5 dB of loss at 1 kHz."

[7] We believe that AFC's standard line cards for its UMC-1000 DLC systems perform to this specification.

[8] DSC Communications Corporation was acquired by Alcatel in 1998.

[9] See, Alcatel/DSC's Litespan 2000 product brochure for a description of the capabilities of this standard POTS remote terminal card, called a RPOTS card.

[10] Alcatel/DSC's card in this category, which they call a RUVG2 card, inserts enough gain to negate at least 2 dB of loss.

[11] The Alcatel/DSC special services extended range card is called a REUVG card. It permits the insertion of up to 6 dB of gain.

[12] Attenuation due to dB loss should only be an issue on long loops. The FCC's Synthesis model engineers loops exceeding 12 kft. on 24-gauge cable, and the HAI Model assumes that all cables smaller than 400 pair (the only kind that practically will be used to serve customers whose loop lengths exceed 12 kft.) are 24-gauge, as well.

[13] DSC, now Alcatel, Practice OSP 363-205-110, *Narrowband Services Application Guide*, 1996, p. 1-25.

[14] Freeman, Roger L., *Fundamentals of Telecommunications*, 1999, p. 101.

Overall Distance Limits

Regardless of whether DC resistance or AC impedance constraints for copper loop transmission are more stringent, the data and analyses presented above demonstrate that analog copper loops terminating at the CO can appropriately be engineered to 18 kft. These data and analyses also suggest that DLC with an analog copper distribution distance shorter thanX kft. (a distance that ranges from 15.9 to 17.6 kft.) may be served using standard POTS remote terminal cards -- regardless of whether the DLC system induces a 2 dB loss at the remote terminal (i.e., have either 6.5 dB or 8.5 dB loss budgets). Whereas loops with analog copper distribution lengths between X kft. and some distance ranging from 20.7 to 23 kft. may be served off of standard POTS cards for DLC systems with an 8.5 dB loss budget, or off of standard extended range POTS cards for DLC systems with a 6.5 dB loss budget.[15] But because analog copper loops over 18 kft. would require load coils that limit bandwidth, the maximum distance that would ever need be served by any DLC card modeled by the FCC Synthesis Model or the HAI Model is 18 kft.

Thus, the modeled cost of line cards for DLC should assume a mix of standard and extended range cards that is in the same proportion as the ratio of analog copper distribution lengths served by DLC systems that are less than X kft., to those that are greater than X kft. (but less than 18 kft.) in distance. Call this fraction of all DLC loops that are less than X kft. in length, Y.

Because a standard extended range POTS card costs roughly 24% more than a standard POTS card, this suggests that if a blended line card cost is used in the chosen model, it should equal:

$$\text{Blended Cost} = Y \cdot Z + (1-Y) \cdot (1.24 \cdot Z)$$

$$= (1.24 - .24 \cdot Y) \cdot Z, \text{ where Z is the cost of the standard card.}$$

[15] In the case of Litespan 2000 DLC systems, this extended range POTS card is its RUVG2 card.